VAPONA (DDVP) EXPOSURE POTENTIAL TO WORKERS IN MUSHROOM HOUSES IN VENTURA COUNTY, CALIFORNIA IN 1981

by

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SUMMARY

Vapona (DDVP) is used to control Phorid flies in some mushroom-growing houses. After its use in one of these houses in Ventura County in early 1981, some workers had complained of headaches and nausea upon reentry after 30 minutes of ventilation. Subsequent monitoring of the houses, reportedly treated in exactly the same manner, revealed air concentrations less than 0.01 parts per million (ppm), which is well below the established state and federal Threshold Limit Value (TLV) of 0.1 ppm for the workplace. Swab samples were also taken of exposed horizontal surfaces of DDVP. The highest concentration found was .026 ug/cm^2 for exposed horizontal surfaces with which workers might have skin contact. This study did not indicate that excessive amounts of DDVP would be present in mushroom houses 30 minutes after application stopped, if the application and subsequent ventilation were in accordance with recommended label requirements.

INTRODUCTION

Vapona (DDVP, dichlorvos, 0,0-dimethyl-2,2-dichlorovinyl-1-phosphate) insecticide is a volatile (vapor pressure 0.012 mm Hg at 20° C.), slightly water soluble compound which has been used for control of Phorid flies (manure flies) inside of mushroom houses. Following use of Vapona for this purpose in a mushroom house in Ventura County, California in early 1981, workers complained of nausea, headaches, and abdominal pain after reentering the house 30 minutes after application. The Worker Health and Safety Unit was requested to investigate.

Some knowledge of typical commercial mushroom culture for this area is necessary to put the use of Vapona in proper context. Wheat straw is mixed with horse stable sweepings and gypsum, piled outdoors, and turned periodically. Heat generation from decomposition takes place, achieving a temperature of 160° F. in the interior of the piles. Tiered wooden beds within the rooms of the mushroom-growing house are manually filled with the composted material removed from a conveyer belt leading into the house. The compost is heated with steam and allowed to stand for 8 to 10 days at a temperature of 140° F., followed by cooling to 74° F. for a few days. Spawning is then initiated by manually introducing mushroom mycelium into the compost. After the spawn has grown for a few weeks, the compost is covered with a thin layer of peat moss as a casing material.

The mushrooms are grown in about 5 or 6 flushes (crops) which are picked periodically over a period of 6 weeks, until the nutrient value of the compost is spent. The spent compost is steamed for 4 hours, then disposed of in the same manner as the beds were filled.

The fresh compost is presumably free of fly eggs due to the intense heat generated during composting. In addition, some operations spray the exterior of the houses with diazinon or malathion. However, flies gain entrance to the houses along with workers entering and leaving or through crevices in the rooms, and can remain to lay eggs in the compost.

These flies are controlled by fumigating the houses with Vapona. Vapona is applied at a rate of 34 grams per 16,000 cubic feet. The applicator places a container of Vapona on a hot plate in the center of the room, turns the plate on, and leaves the premises, closing the outer doors. The interior forced air circulating fans are then run for 20 minutes. When the application is completed, the forced air exhaust fans are turned on to a high-speed setting and allowed to run for 30 minutes. After 30 minutes of exhausting air from the treated room, the fans are turned down to their normal speed, and workers are allowed to reenter without protective clothing. Each room studied had approximately 80,000 cubic feet of space, and 10 air changes occurred in a room during one-half hour of ventilation with exhaust fans running at high speed.

MATERIALS AND METHODS

Air samples were collected from selected work areas to determine levels of inhalation exposure, and swab samples of horizontal surfaces with which workers would have skin contact were collected for levels of dermal exposure.

Air Samples: Vapona was trapped on XAD-4 porous polymer resin tubes (SKC 226-30-11-04) drawn by MSA Model S personal air sampling pumps. The pumps operated at a flow-rate of one liter per minute for 50 min., with one exception (see Sampling Timetable). The 30-minute post-application samples were collected after the forced air exhaust fans had operated for 30 minutes and when the workers could be permitted to enter the houses in accord with the label statement. Air samplers were located in the center of the mushroom houses.

Air Sampling Timetable

Preapplication

30 minute post-application (for 30 minutes)

1 hour post-application
3 hours post-application
6 hours post-application
12 hours post-application
24 hours post-application

Swab Samples: These were collected from the upper tiers which the workers must climb on to irrigate the mushrooms. Areas of the wooden tiers were measured with a template, then swabbed with 3 Kimwipe laboratory tissues each moistened with 10-15 ml ethyl acetate.

Swab Sampling Timetable

Preapplication

30 minutes post-application
3 hours post-application
12 hours post-application

All samples were chilled with ice and shipped by airplane to the Department's chemistry laboratory in Sacramento for analysis by gas-liquid chromatography as given in the Appendix.

RESULTS

Air Sample Residues of DDVP in PPM

Rooms	4	6	52	124
preapplication	ND	ND	ND	ND
during application	-*	-	0.054	0.061
30 minutes post-application	0.0107	0.0025	0.0068	0.0023
1 hour post-application	-	-	0.0028	0.0035
3 hours post-application	0.0046	0.0005	0.0017	0.0044

* Dash means no sample collected.

Air Samples of Residues of DDVP in PPM

Rooms	4	6	52	124
6 hours post-application	0.0054	0.0004	0.0003	0.0037
12 hours post-application	0.0019	0.0004	0.0134	0.0035
24 hours post-application	0.0028	0.0008	-	-

Swab Samples of DDVP in ug/cm^2

Rooms	52	124
preapplication	ND	ND
30 minutes post-application	0.014	0.007
3 hours post-application	0.026	0.003
12 hours post-application	0.014	ND

(ND - Not detected)

DISCUSSION

These data indicate that the Vapona levels in the air inside the houses after fumigation did not exceed the federal or state OSHA exposure limits (0.1 ppm).

The samples of the surfaces that workers would be handling also indicated very low levels, presenting very little possibility of substantial dermal exposure.

There appears to be little likelihood that these exposure levels have a potential for any short- or long-term toxicity (serum and RBC cholinesterase inhibition and neurological toxicity), but it cannot be irrevocably ruled out that the symptoms previously reported by workers were not due to excess exposure to Vapona. However, to more firmly establish the presence (or lack thereof) of a causal link between Vapona exposure and worker symptoms, a more detailed survey of the workers involved would be required, including inquiries into their personal habits and health status, as well as blood sampling assaying for changes in levels of serum and RBC cholinesterase. It is possible that their previous illnesses were associated with an excessive application or inadequate ventilation.

Nausea had been reported only among the irrigators, the workers who enter the houses shortly after fumigation and venting. Symptoms had not been reported among the pickers who do not enter until the following day. The owners have altered their operation so that there is a 12-hour interval before any workers reenter the houses, rather than the 30-minute minimum required by the label. No further symptoms of toxicity have been reported among mushroom workers since these changes were made.